WEST

Generate Collection

L10: Entry 1 of 2 File: USPT Sep 25, 2001

DOCUMENT-IDENTIFIER: US 6294217 B1
TITLE: Methods and compositions for producing microlenses and optical filters

DEPR:
The droplets can be placed on the substrate by suspending the droplet from a wire (i.e. wire transformation) and touching the fluid to the substrate. Alternatively, droplets can be dropped onto the substrate through the surrounding atmosphere by a technique such as using an ink jet printer.

DEPR:
The precursor composition can be applied to a substrate surface by vapor deposition, or dropping or propelling it from some distance from the surface, as by an ink jet printer.

CLPR:
1. A method of producing a microlens on a substrate comprising the steps of:

CLPR:
2. A method of producing a microlens on a substrate comprising the steps of:

CLPR:
3. A method of forming a microlens structure having a desired pattern on a substrate comprising the steps of:

CLPR:
12. A method of forming a pattern of metal doped microlens on a substrate comprising the steps of:

CLPV:
c) thermally oxidizing the precursor droplet to form a microlens, said silicone precursor composition selected from the group consisting of vinyl containing polygermanosiloxane ##STR9##

CLPV:
c) thermally oxidizing the precursor droplet to form a microlens, said silicone precursor composition selected from the group consisting of ##STR11##

CCOR:
427/164

(c) ejecting drops of said liquid optical element forming material from said election device to a surface to be wetted, wherein said micro-optical components are plano-convex microlenses and wherein adjacent drops of said liquid optical element forming material ejected from said ejection device to said surface to be wetted coalesce into a single elliptical droplet prior to solidification to form a plano-convex hemi-elliptical microlens.

CLPW:
wherein said surface to be wetted comprises an end of an optical fiber, wherein said optical fiber has a diameter of from 50 to 300 .mu.m and wherein multiple drops of said optical element forming material are deposited on said end of said optical fiber to produce a microlens having a radius of curvature that varies with the number of drops of said optical element forming material deposited.

CCOR:
427/162

WEST

Generate Collection

L10: Entry 1 of 2 File: USPT Sep 25, 2001

US-PAT-NO: 6294217
DOCUMENT-IDENTIFIER: US 6294217 B1

TITLE: Methods and compositions for producing microlenses and optical filters

DATE-ISSUED: September 25, 2001

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Risen, Jr.; William M.	Rumford	RI	02916	N/A
Wang; Yong Zhong	Providence	RI	N/A	N/A

US-CL-CURRENT: 427/164; 427/226

CLAIMS:

Having thus described the invention, it is claimed:
1. A method of producing a microlens on a substrate comprising the steps of:
a) preparing a carboxylated silicone precursor composition;
b) applying the carboxylated silicone precursor composition to a surface of a substrate to form a precursor droplet; and
c) thermally oxidizing the precursor droplet to form a microlens, said silicone precursor composition selected from the group consisting of vinyl containing polygermanosiloxane ##STR9##
wherein R.sub.1 through R.sub.6 are selected from the group consisting of alkyl and alkene groups and R.sub.7 is a vinyl group and carboxylated polygermanosiloxane ##STR10##
wherein R.sub.1 through R.sub.5 are alkyl groups and R.sub.6 is an alkyl radical.
2. A method of producing a microlens on a substrate comprising the steps of:
a) preparing a carboxylated silicone precursor composition;
b) applying the carboxylated silicone precursor composition to a surface of a substrate to form a precursor droplet; and
c) thermally oxidizing the precursor droplet to form a microlens, said silicone precursor composition selected from the group consisting of ##STR11##
wherein m/(n+m) is from 0.14 to 0.999.
3. A method of forming a microlens structure having a desired pattern on a substrate comprising the steps of:
a) preparing a carboxylated silicone precursor composition;
b) depositing the carboxylated silicone precursor composition on the surface of a substrate to form a precursor film;
c) masking the precursor film with a mask having a desired

pattern of spherical shaped droplets;
d) exposing the masked precursor film to radiation thereby cross-linking the unmasked precursor film to form a pattern of spherical shaped droplets;
e) washing the precursor film with an organic solvent to remove uncross-linked precursor film from the substrate and leaving cross-linked precursor film in the form of a pattern on the substrate; and,
f) thermally oxidizing the cross-linked precursor film to form a pattern of spherical shaped droplets on the substrate.
4. The method of claim 3 further comprising the step of adding a photoinitiator to the carboxylated silicone precursor composition prior to deposition.
5. The method of claim 3 wherein said carboxylated silicone precursor composition is selected from the group consisting of carboxylated polysiloxane, carboxylated polygermianosiloxane, carboxylated germanium sesquioxide siloxane copolymer, and germanium esters of carboxylated polysiloxane.
6. The method of claim 5 wherein said carboxylated polysiloxane is poly(carboxypropylmethyl) siloxane.
7. The method of claim 5 wherein said carboxylated polygermanosiloxane is selected from the group consisting of vinyl containing carboxylated polygermanosiloxane and carboxylated polygermanosiloxane.
8. The method of claim 5 wherein said carboxylated polysiloxane is ##STR12##
wherein m/(n+m) is from 0.14 to 0.999.
9. The method of claim 5 wherein said germanium esters of carboxylated polysiloxanes are germanium esters of ##STR13## wherein m/(n+m) is from 0.14 to 0.999.
10. The method of claim 3, wherein said substrate is selected from the group consisting of silica, silicate glass, and silicon.

11. The method of claims 10, wherein said substrate is a borosilicate glass.
12. A method of forming a pattern of metal doped microlens on a substrate comprising the steps of:
a) preparing a carboxylated silicone precursor composition;
b) depositing the carboxylated silicone precursor composition on the surface of a substrate to form a precursor film;
c) masking the precursor film with a mask having a desired pattern of spherical shape droplets;
d) exposing the masked precursor film to radiation thereby cross-linking the unmasked precursor film to form a pattern of spherical shaped droplets;
e) washing the precursor film with an organic solvent to remove the uncross-linked precursor film from the substrate and leaving the cross-linked precursor film on the substrate in the form of a pattern of spherical shaped droplets;
f) applying a metal organic composition to the cross-linked precoursor film therby forming by ion-exchange a pattern of metal doped precursor droplets; and,
e) thermally oxidizing the metal doped precursor droplets to form a pattern of a metal doped droplets on a substrate.
13. The method of claim 12, further comprising the step of adding a photoinitiator to the carboxylated silicone precursor composition prior to deposition.

14. The method of claim 12 wherein said carboxylated silicone composition is selected from the group consisting of carboxylated polysiloxane, carboxylated polygermanosiloxane, carboxylated germanium sesquioxide siloxane copolymer, and germanium esters of carboxylated polysiloxane.
15. The method of claim 14 wherein said carboxylated polysiloxane is selected from the group consisting of poly(carboxypropylmethyl) siloxane ##STR14##
16. The method of claim 14, wherein said carboxylated polygermanosiloxane is selected from the group consisting of carboxylated polygermanosiloxane ##STR15##
wherein R.sub.1 through R.sub.5 are alkyl groups and R.sub.6 is an alkyl radical, and vinyl containing polygermanosiloxane ##STR16##
wherein R.sub.1 through R.sub.6 are selected from the group consisting of alkyl and alkyl and alkene groups and R.sub.7 is a vinyl group.
17. The method of claim 14 wherein said carboxylated polysiloxane is ##STR17##
wherein m/(n+m) is from 0.14 to 0.999.
18. The method of claim 14 wherein said germanium esters of carboxylated polysiloxane are germanium esters of ##STR18##
wherein m/(n+m) is from 0.14 to 0.999.
19. The method of claim 12 wherein said substrate is selected from the group consisting of glass, silicon and silica oxide glasses.
20. The method of claim 19 wherein said substrate is a borosilicate glass.
21. The method of claim 12 wherein said thermal oxidization occurs according to a time-temperature program comprising the steps of:
a) heating from 25.degree. C. to 200.degree. C. in about 5 min.;
b) heating at 200.degree. C. for 40-50 min.;
c) heating from 200.degree. C. to 250.degree. C. in about 1.5 min. and at 250.degree. C. for 30-60 min.;
d) heating from 250.degree. C. to 500.degree. C. in about 6.5 min. and at 500.degree. C. for 60-210 min.;
e) heating from 500.degree. C. to 550.degree. C. in about 1.5 min. and at 550.degree. C. for 25-50 min.;
f) heating from 550.degree. C. to 600.degree. C. in about 1.5 min. and at 600.degree. C. for 60-140 min.; and,
g) cooling to 25.degree. C. over a period of 30-60 min.
22. The method of claim 12 wherein said radiation is ultra-violet light.
23. The method of claim 12 wherein said metal organic composition comprises metal ions selected from the group consisting of alkali metals, transition metals and rare earth (lanthanide) metals.

WEST

End of Result Set

Generate Collection

L10: Entry 2 of 2 File: USPT Jan 13, 1998

DOCUMENT-IDENTIFIER: US 5707684 A
TITLE: Method for producing micro-optical components

BSPR:
The method of the present invention involves the application of data driven ink-jet droplet dispensing technology to form and place microscopic droplets of optical materials to create micro-optical components for use with diode lasers and amplifiers. The method of the present invention also involves the delivery of droplets of optical materials directly onto the output facets of diode lasers to improve their performance and onto optical substrates to form arrays of high numerical aperture microlenses for coupling arrays of diode lasers, amplifiers and optical fibers.

BSPR:
The ink-jet printing methods of the present invention provide a means for data-driven fabrication of micro-optical elements such as refractive lenslet arrays, multimode waveguides and microlenses deposited onto the tips of optical fibers. The materials that can be used for microjet printing of micro-optics include optical adhesives and index-tuned thermoplastic formulations. By varying such process parameters as numbers and locations of deposited microdroplets, print head temperature and orifice size, and target substrate temperature and surface wettability, arrays of spherical and cylindrical plano-convex microlenses can be fabricated with dimensions ranging from 80 .mu.m to 1 mm to precision levels of just a few microns, along with multimode channel waveguides. An optical telescope system yielding optical performance data such as lenslet f/#'s and far-field patterns along with beam-steering agility data can be assembled from microlens arrays printed according to the method of the present invention.

CLPR:
4. A method according to claim 3 wherein the shape of said plano-convex, hemi-elliptical microlens may be adjusted by adjusting the formulation of said optical element forming material, the size of said drops, the number of drops deposited, the spacing of said drop on said surface to be wetted, the temperature differential between said ejected optical element forming material and said surface to be wetted, and the wettability of said surface to be wetted.

CLPV:

WEST

End of Result Set

Generate Collection

L10: Entry 2 of 2 File: USPT Jan 13, 1998

US-PAT-NO: 5707684
DOCUMENT-IDENTIFIER: US 5707684 A

TITLE: Method for producing micro-optical components

DATE-ISSUED: January 13, 1998

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Hayes; Donald J.	Plano	TX	N/A	N/A
Cox; W. Royall	Plano	TX	N/A	N/A

US-CL-CURRENT: 427/162; 347/1, 427/163.2, 427/226, 427/256, 427/279, 427/385.5, 427/389.7

CLAIMS:

What is claimed is:
1. A method for producing micro-optical components, comprising the steps of:
(a) maintaining an optical element forming material in a liquid state in an ejection chamber;
(b) transferring said liquid optical element forming material from said ejection chamber to an ejection device;
(c) maintaining said optical element forming material in a liquid state in said ejection device, said optical element forming material having a viscosity of less than 20 centipoise at a temperature of from 100.degree. to 200.degree. C. in said ejection device; and
(d) ejecting drops of said liquid optical element forming material from said ejection device to a surface to be wetted.
2. A method for producing micro-optical components, comprising the steps of:
(a) maintaining an optical element forming material in a liquid state in an ejection chamber;
(b) transferring said liquid optical element forming material from said ejection chamber to an ejection device; and
(c) ejecting drops of said liquid optical element forming material from said ejection device to a surface to be wetted wherein said surface to be wetted comprises an end of an optical fiber, wherein said optical fiber has a diameter of from 50 to 300 .mu.m and wherein multiple drops of said optical element forming material are deposited on said end of said optical fiber to produce a microlens having a radius of curvature that varies

with the number of drops of said optical element forming material deposited.

3. A method for producing micro-optical components, comprising the steps of:

(a) maintaining an optical element forming material in a liquid state in an ejection chamber;

(b) transferring said liquid optical element forming material from said ejection chamber to an election device; and

(c) ejecting drops of said liquid optical element forming material from said election device to a surface to be wetted, wherein said micro-optical components are plano-convex microlenses and wherein adjacent drops of said liquid optical element forming material ejected from said ejection device to said surface to be wetted coalesce into a single elliptical droplet prior to solidification to form a plano-convex hemi-elliptical microlens.

4. A method according to claim 3 wherein the shape of said plano-convex, hemi-elliptical microlens may be adjusted by adjusting the formulation of said optical element forming material, the size of said drops, the number of drops deposited, the spacing of said drop on said surface to be wetted, the temperature differential between said ejected optical element forming material and said surface to be wetted, and the wettability of said surface to be wetted.